

## Plasma Reduction of Lunar Regolith for In-Space Fabrication, Phase II

Completed Technology Project (2006 - 2008)



## Project Introduction

Tools for extracting resources from the moon are needed to support future space missions. Of particular interest is the production of gases and metals for life support, propulsion, and in-space fabrication. The only practical source for these materials is the decomposition of lunar regolith. Described herein is an innovative plasma reduction technique for the production of gases and metal powders. This technique is characterized by its high temperatures and rapid quenching. During Phase 1, silicon, iron, and magnesium in crystalline form were produced using the plasma reduction technique. Based on the analysis of captured gas samples and the fact that metallic species were produced, oxygen was also evolved as a result of plasma processing. During Phase 2, the plasma techniques developed during Phase 1 will be optimized. Techniques to separate and collect pure oxygen from the regolith and the processing gases will be developed. Steps will be taken to reduce the power requirements needed for plasma reduction. Additional metals such as aluminum, titanium, and calcium will also be produced by varying processing parameters. Precise measurement of particle temperature and velocity will be performed and correlated with processing parameters and thermodynamic calculations so that these objectives can be met.

## Anticipated Benefits

Potential NASA Commercial Applications: Potential commercial applications for metal powders include in-situ powder metallurgical products, ultra-thin protective coatings, high surface area/volume ratio catalysts, composite additives, sintering aids, porous structures in microfiltration membranes, additives for solid and hybrid rocket fuels that provide a more efficient combustion process, electrically-conductive adhesives and polymers, component materials for crew vehicles and habitats, semiconductor devices, and high-power electronics for electric vehicles.



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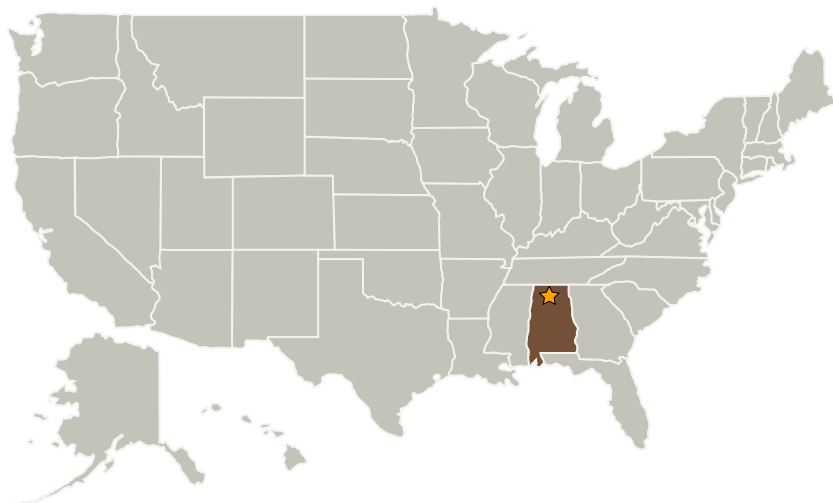
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## Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★ Marshall Space Flight Center (MSFC)	Lead Organization	NASA Center	Huntsville, Alabama
Plasma Processes, LLC	Supporting Organization	Industry Veteran-Owned Small Business (VOSB)	Huntsville, Alabama

## Primary U.S. Work Locations

Alabama

## Project Transitions

**December 2006:** Project Start**November 2008:** Closed out

## Organizational Responsibility

**Responsible Mission Directorate:**

Space Technology Mission Directorate (STMD)

**Lead Center / Facility:**

Marshall Space Flight Center (MSFC)

**Responsible Program:**

Small Business Innovation Research/Small Business Tech Transfer

## Project Management

**Program Director:**

Jason L Kessler

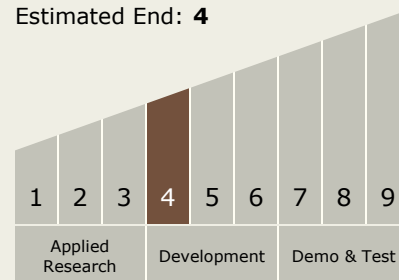
**Program Manager:**

Carlos Torrez

**Principal Investigator:**

John Scott S O'dell

## Technology Maturity (TRL)

Current: **4**  
Estimated End: **4**

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## Technology Areas

### Primary:

- TX07 Exploration Destination Systems
  - └ TX07.1 In-Situ Resource Utilization
    - └ TX07.1.3 Resource Processing for Production of Mission Consumables